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editor and publisher
WILLIAM M. AVERY

co-publisher
JOHN M. ENGLE

assistant editor
CLARISSA B. McKNIGHT

contributing editor
RALPH IRONMAN

production manager
DOROTHY LUXFORD

distribution manager
DOROTHY MOUCKA

ADVERTISING OFFICES

home office
P. O. Box 444—Elmhurst, Ill.
TErrace 4-5110

east coast
WALTER J. MASTERSON JR.
P. O. Box 206—Essex, Conn.
South 7-1838

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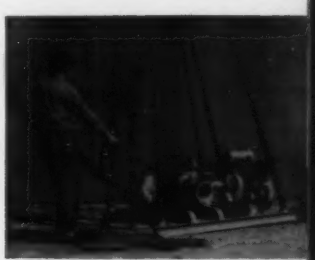
COMING NEXT MONTH

Cement Mason's Manual—Part V. In the March installment our series will discuss the tools and techniques required to produce such special surface finishes as exposed aggregate, geometric designs, leaf impressions, and circle, swirl and wavy broom designs.

Vermiculite Concrete. The third article in our series on lightweight concrete deals with one of the important aggregates classified as ultra-lightweight, and used mainly for light structural roof decks and for insulation and fill work over metal decking and structural concrete.



Testing Pays. Without the protection of some basic testing work, the concrete construction game is about as hazardous as Russian roulette. This article will deal with minimum requirements.

Over 36,000 copies mailed. Edited for all who are concerned with quality, job placed concrete (including prestress, tilt-up, lift slab, and thin-shell)—its specification, production, handling, forming, reinforcing, placing, finishing and curing: *Concrete Contractors, General Contractors, Engineers, Architects, Industrial Construction and Maintenance Men, Highway Engineers, Ready-Mix and Prestressed Concrete Producers.*

About our page numbers: The pages of Concrete Construction Magazine are numbered consecutively from January through December each year as a means of facilitating the use of bound volumes for reference purposes.

constructing concrete flatwork

FIG. 28.

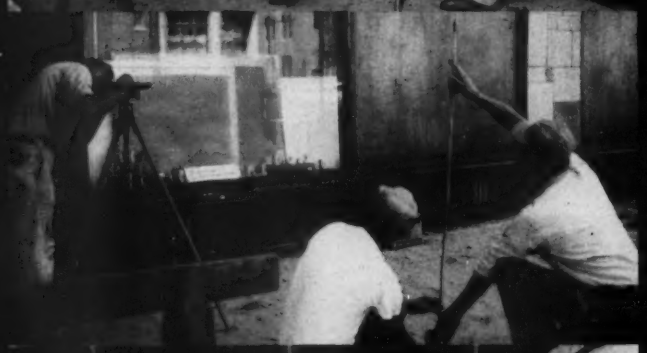


FIG. 29.

FIG. 30.

FIG. 31.

FIG. 32.

FIG. 33.

FILE: Finishing

PREPARING THE SITE AND PLACING THE CONCRETE

Before placing any concrete the forms or screeds must be set to proper grade. The grade is sometimes determined by using a builder's level. The level is sighted on a measuring rod or rule that is set on an established grade (Fig. 28) and a reading is taken. Then the rod or rule is moved to where the form or screed will be placed (Fig. 29). With a stake in the ground at this point the rod or rule is raised or lowered until the desired grade is read by the level. A mark or nail is placed on the stake at the bottom of the rule (Fig. 30). This operation continues until enough stakes are set and marked with the proper grade and alignment.

A string line is then strung tightly from stake to stake at the marked position (Fig. 31). This string line will be at the top of the form or screed. The distance from the string line to the subgrade is checked to make sure there is enough depth to place the form or screed (Fig. 32). If not, the subgrade is dug out until there is enough clearance. The forms or screeds are then set to proper line and grade by following the string line (Fig. 33).

This article is an authorized reprint from the *Cement Mason's Manual*, a new publication of the Portland Cement Association.

The forms or screeds are then well staked and braced. The stakes must be driven straight to ensure that the forms or screeds will be true and plumb. When the grade of a narrow walk is being established it is sometimes more convenient to set one edge form and then use a spirit level, as shown in Fig 34, to set the other edge form.

All sod and vegetable matter must be removed from the construction site and any soft or mucky places must be dug out, filled with at least 2 in. of granular material, such as sand, gravel or crushed stone, and thoroughly tamped (Fig. 35). Exceptionally hard compact spots must be loosened and then tamped to provide the same uniform support for the slab as the remainder of the subgrade.

When additional fills are required under walks, driveways or floors to bring them to the proper grade, the fills should also be of a granular material thoroughly compacted in a maximum of 4-in. layers. It is best to extend the top of all fills at least 1 ft. beyond the edges of walks and drives, and to make the slope of the fill flat enough to prevent undercutting during rains.

The top 6 in. of the subgrade should be of sand, gravel or crushed stone where subgrades are water soaked most of the time. These granular subgrades must be drained to prevent the collection of water. Well-compacted, well-drained subgrades do not require such special granular treatment.

Where a new concrete slab abuts an existing walk, driveway, building, curb, lighting standard, fireplug or other rigid object, a premolded material, usually 1/2 in. thick, should be placed at the joint. These joints are commonly called expansion joints. They are placed on all four sides of the square formed by the intersection of two walks. When the sidewalk fills the space between the curb and a building or wall, an expansion joint should be placed between the sidewalk and the curb and between the sidewalk and the building or wall. Expansion joints are not required at regular intervals in the sidewalk.

The concrete should contain only enough water to produce a concrete that has a relatively stiff consistency (Fig. 36) and works readily and does not segregate. Concrete should have a slump of about 3 in. when tested with a standard slump cone. The adding of more mixing water to produce a higher slump than specified lessens the durability and reduces the strength of the concrete.

In northern climates where concrete flat surfaces are subjected to freezing and thawing, air-entrained concrete is necessary. Air-entrained concrete is made by using an air-entraining portland cement or by adding an air-entraining agent during mixing.

Before the concrete is placed, the subgrade should be thoroughly dampened so that it is moist throughout,

FIG. 34.

FIG. 35.

FIG. 36.

but without puddles of water (Fig. 37).

Concrete should be placed between the forms or screeds as near to its final position as practicable. Precautions should be taken not to overwork the concrete while it is still plastic because an excess of water and fine material will be brought to the surface, which may lead to scaling or dusting later on.

The concrete should be thoroughly spaded along the forms or screeds to eliminate voids or honeycombs at the edges (Fig. 38).

FINISHING THE CONCRETE SURFACE

Any craftsman or tradesman should understand the nature and properties of the material with which he works. A cement mason should understand the nature of concrete, and the different problems in working with concrete made with the various types of portland cement.

Generally, all the dry materials used in making quality concrete are heavier than water. Thus, shortly after placement, these materials will have a tendency to settle to the bottom and force any excess water to the surface. This reaction is commonly called "bleeding." This bleeding usually occurs with non-air-entrained concrete. It is of utmost importance that the first operations of placing, screeding and darbying be performed before any bleeding takes place. The concrete should not be allowed to remain in wheelbarrows, buggies or buckets any longer than is absolutely necessary. It should be dumped and spread as soon as possible and struck off to proper grade, and then immediately screeded—followed at once by darbying. These last two operations should be performed before any free water has bled to the surface. The concrete should not be spread over a large area before screeding – nor should a large area be screeded and allowed to remain before darbying. *If any operation is performed on the surface while the bled water is present, serious scaling, dusting or crazing can result.* This point cannot be overemphasized and is the basic rule for successful finishing of concrete surfaces. (An explanation of the causes of scaling, crazing and dusting begins on page 30.)

The surface is struck off or rodded by moving a straightedge back and forth with a sawlike motion across the top of the forms or screeds. A small amount of concrete should always be kept ahead of the straightedge to fill in all the low spots and maintain a plane surface (Fig. 39).

On some jobs the next operation is using the hand tamper or jitterbug (Fig. 40). But this tool should be used sparingly and in most cases not at all. If used, it should be used only on concrete having a low slump (1 in. or less) to compact the concrete into a dense mass. Jitterbugs are sometimes used on industrial floor

FIG. 37.

FIG. 38.

FIG. 39.

FIG. 40.

construction because the concrete for this type of work usually has a very low slump, with the mix being quite stiff and perhaps difficult to work.

The hand tamper or jitterbug is used to force the large particles of coarse aggregate *slightly* below the surface in order to enable the cement mason to pass his darby over the surface without dislodging any large aggregate.

After the concrete has been struck off or rodded, and in some cases tamped, it is smoothed with a darby to level any raised spots and fill depressions (Fig. 41). Long-handled floats of either wood or metal, called bull floats, are sometimes used instead of darbies to smooth and level the concrete surface (Fig. 42).

When all bled water and water sheen has left the surface and the concrete has started to stiffen, it is time for the other finishing operations. Where edging is necessary (Fig. 43), this could be the next operation. This produces a rounded edge or radius on the edge of the slab to prevent chipping or damage to the edge of the concrete slab. The edger should be run back and forth until a finished edge is produced. The cement mason should be careful that all coarse aggregate particles are covered and that the edger does not leave too deep an impression in the top of the slab, otherwise the indentation may be difficult to remove with subsequent finishing operations.

Immediately following edging, the slab is jointed (or grooved). The cutting edge or bit of the jointing tool cuts joints in the slab called control or contraction joints. These joints are used to control any cracking tendency in the concrete that may be due to shrinkage stresses caused by drying out or by temperature changes. The joints provide a reduction in slab thickness and thus create a weakened section that induces cracking to occur at that location. When the concrete shrinks, the cracks in these joints can open slightly, thus preventing irregular and unsightly random cracks. In sidewalk and driveway construction the tooled joints are usually spaced at intervals equal to the width of the slab (Fig. 44), but not more than 20-ft. intervals. For control joints the jointer should have a 3/4-in. bit. If the slab is to be grooved only for decorative purposes, jointers having shallower bits may be used.

It is good practice to use a straight 1x8 or 1x10 board as a guide when making the groove in the concrete slab. If the board is not straight it should be planed true. The tooled joints should be perpendicular to the edge of the slab. The same care must be taken in running joints as in edging, for a tooled joint can add to or detract from the appearance of the finished slab.

On large concrete flat surfaces it may be more convenient to cut joints with an electric or gasoline-driven power saw fitted with an abrasive or diamond blade (Fig. 45). Joints made with a power blade should be

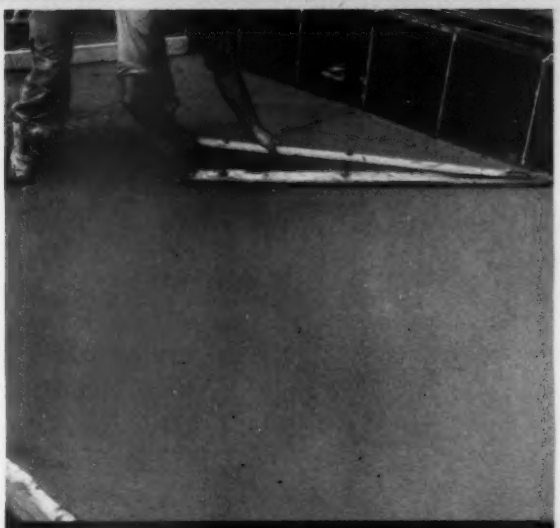


FIG. 41.

FIG. 42.

FIG. 43.

FIG. 44.

FIG. 45.

FIG. 46.

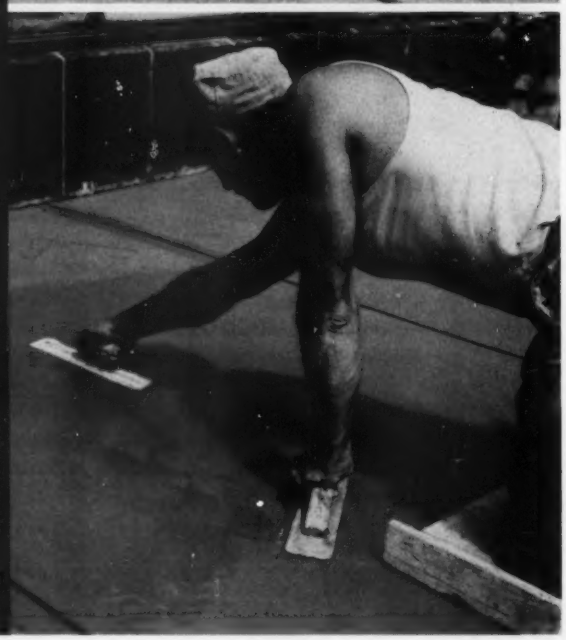


FIG. 47.

cut within 4 to 12 hours after the slab has been placed and finished. Cutting of joints must be done as soon as the concrete surface is firm enough not to be torn or damaged by the blade, and before random shrinkage cracks can form in the concrete slab.

After edging and hand jointing operations, the slab should be floated. Many variables—concrete temperature, air temperature, relative humidity, wind, etc.—make it difficult to set a definite time to begin floating. This knowledge comes only through a great deal of on-the-job experience.

The purpose of floating is threefold: (1) to embed large aggregates just beneath the surface; (2) to remove slight imperfections, humps and voids to produce a level or plane surface; (3) to consolidate mortar at the surface in preparation for other finishing operations.

Aluminum or magnesium floats should be used, especially on air-entrained concrete. This type of metal float greatly reduces the amount of work required by the finisher, because the drag is reduced and the float slides more readily over the concrete surface, but still has a good floating action. A wood float tends to stick to and tear the concrete surface. The light metal float forms a smoother surface texture than the wood float.

The marks left by the edger and jointer should be removed by floating (Fig. 46) unless such marks are desired for decorative purposes, in which case the edger or jointer should be rerun after the floating operation.

Immediately following floating, the surface should be steel-troweled. It is customary for the cement mason to float and then steel-trowel an area before moving his knee boards (Fig. 47). If necessary, tooled joints and edges should be rerun before and after troweling to maintain uniformity or to remove kinks.

The purpose of troweling is to produce a smooth, hard surface. For the first troweling, whether by power or by hand, the trowel blade must be kept as flat against the surface as possible. If the trowel blade is tilted or pitched at too great an angle, an objectionable "washboard" or "chatter" surface will result. For first troweling a new trowel is not recommended. An older trowel which has been "broken" can be worked quite flat without the edges digging into the concrete. The smoothness of the surface could be improved by timely additional trowelings. There should necessarily be a lapse of time between successive trowelings in order to permit concrete to increase its set. As the surface stiffens each successive troweling should be made by smaller-sized trowels to enable the cement mason to use sufficient pressure for proper finishing.

The steel-troweled surface leaves the concrete very smooth. However, such surfaces become quite slippery when wet and should be slightly roughened to produce a nonslip surface. This can be done by brushing or brooming the surface. The brushed surface is made by

drawing a soft-bristled push broom with a long handle over the surface of the concrete slab after steel-troweling. Note in Fig. 48 that the workman is drawing the broom right over the joint, but the joint is not being marred. This indicates that the concrete surface has been steel-troweled properly and is hard enough so the edges of the joint will not be damaged.

When coarser textures are desired, because of steep slopes, a stiffer bristled broom may be used. Other types of surface finishes, such as exposed aggregate, color and geometric design will be discussed in a later section.

FINISHING AIR-ENTRAINED CONCRETE

Air entrainment gives concrete a somewhat altered consistency that requires a little change in finishing operations from those used with non-air-entrained concrete.

Air-entrained concrete contains microscopic air bubbles that tend to hold all the materials in the concrete, including water, in suspension. This type of concrete requires less mixing water than non-air-entrained concrete, and still has good workability with the same slump. Since there is less water and it is held in suspension, little or no bleeding occurs. This is the reason for slightly different finishing procedures. With no bleeding, there is no waiting for the evaporation of free water from the surface before starting floating and troweling. This means that in general floating and troweling should be started sooner—before the surface becomes too dry or tacky. If floating is done by hand, the use of an aluminum or magnesium float is essential. A wood float drags and greatly increases the amount of work necessary to accomplish the same result. If floating is done by power there is practically no difference between finishing procedures for air-entrained and non-air-entrained concrete, except that we may start floating sooner on the air-entrained concrete.

Practically all horizontal surface defects and failures are caused by finishing operations performed while bled water or excess surface moisture is present. Better results are generally accomplished, therefore, with air-entrained concrete.

CURING

Curing of a concrete slab is one of the most important construction operations, but is often one of the most neglected. Concrete properly mixed, placed and finished will still result in a poor job if proper curing operations are not followed.

Concrete should be protected so that little or no moisture is lost during the early stages of hardening. Newly placed concrete should not be permitted to dry out too fast and must be protected from the sun and drying winds. This may be done with burlap or canvas coverings kept continuously wet. As soon as the concrete has hardened enough so that the surface will not be marred, the burlap or canvas can be replaced with coverings of earth, sand or straw kept moist for at least 3 days by occasional sprinkling. Another method of moist curing is by ponding, which is done by keeping an inch or so of water on the concrete surface. The water can be confined by earth dikes around the edges of the slab. Watertight paper or polyethylene film are also widely used for coverings. Laps in such coverings should be taped to prevent moisture loss. Membrane curing compounds sprayed on the surface of the concrete are often used and should be applied immediately after the concrete has been given its final finish (Fig. 49). Adequate and uniform coverage by curing compounds is essential, and in some cases two applications may be required. Additional information on curing is given in later sections on hot and cold weather concreting.

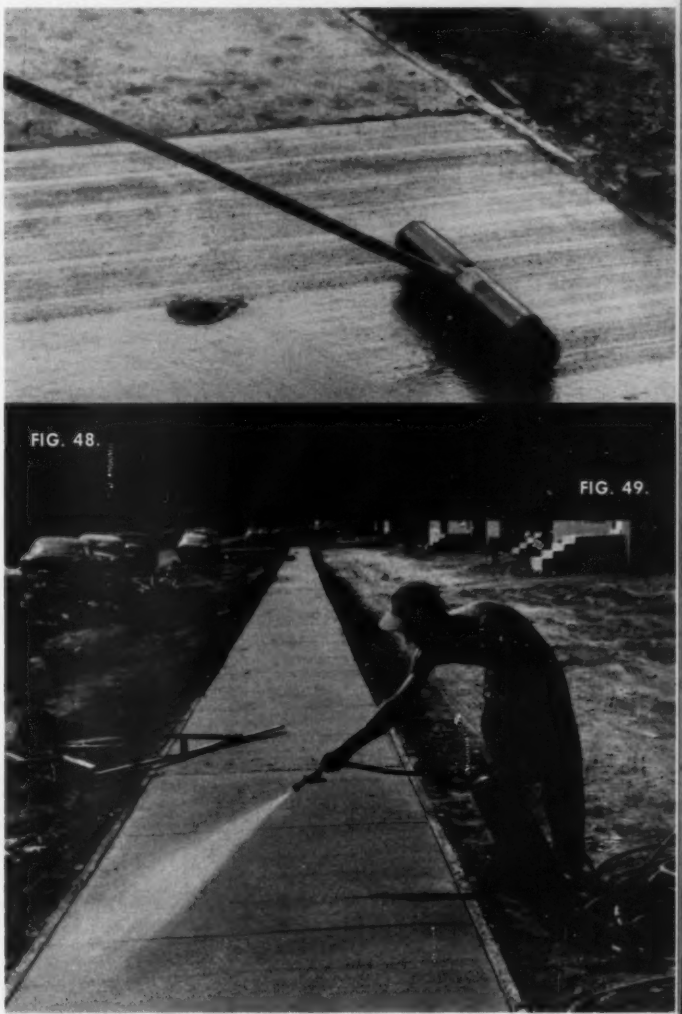


FIG. 48.

FIG. 49.

Lightweight Structural Concrete

COST CONSCIOUSNESS and a desire to utilize new designs has stimulated builders' interest in lightweight structural concrete. This, in turn, has stimulated an increase in the supply of expanded clay, slate, shale and slag aggregates used to produce such concrete. In 1959 about 4 million tons of expanded shale, clay, and slate aggregates and about 3 million tons of expanded slag aggregates were marketed. Thirty percent of the production of expanded clay, shale, and slate, and around 5 percent of the expanded slag aggregates was used in structural cast-in-place concrete.

As those who have used it know, lightweight concrete effects considerable savings in building steel and deadweight, and, in many cases, makes possible the addition of several stories without radically altering basic plans.

The production of expanded slag lightweight aggregates is confined to areas where the iron and steel industry is concentrated. Both mechanical and non-mechanical means are employed to turn out these aggregates. In each method, molten slag is treated with a controlled quantity of water to produce a strong, highly vesicular aggregate.

There are several processes currently used for manufacturing expanded slag aggregates. In the Kinney-Osborne process the slag first passes through a diaphragm and then is treated with either air, steam or water. In the Caldwell machine water is mixed with the slag in a cylindrical casing and radial blades fling the expanded product through an opening in the casing to a steel target a few feet away. In the Brosius machine the slag flows radially in a sheet over the upper surface of a centrifuge where it is sprayed with water.

The non-mechanical means of producing expanded slag is called the jet or pit system. Here molten slag falls in a stream in front of a nozzle which emits steam, air, and water. Expansion occurs as the slag falls. Regardless of the method of processing expanded slag, so long as the grading and weight of the finished products stay the same, the strength, weight and other properties of concretes made with these materials will be reasonably uniform.

Until recently little has been known about the complex nature of clay, slate, and shale, the temperatures that cause fusion in the materials, and the gases that cause them to expand. Investigations by the Portland Cement Association, the American Concrete Institute, the National Ready Mixed Concrete Association, the Expanded Shale, Clay and Slate Institute, and other organizations have done much to bring about fuller understanding of these raw materials. The production of expanded lightweight aggregates from clay, slate and shale now approaches the status of a science, rather than being a trial and error operation.

Lightweight aggregates from shale, clay and slate are produced in a rotary kiln or are sintered on a moving grate. In the rotary kiln method, the raw material is fed into the upper end of the kiln and travels slowly to the burner end. Expansion occurs in the burning zone at temperatures of 1,800 to 2,200 degrees F., after which the expanded material is discharged into a cooling pit. The clay, slate or shale is then crushed, screened and stockpiled. The process is varied somewhat to produce coated lightweight aggregate, a material which is presized during burning.

In the sintering method, crushed and screened materials are mixed with a small amount of fine coal or coke in a pelletizing machine. The charge is spread evenly to a depth of eight to twelve inches over a moving grate and passes through an ignition hood where the fuel is ignited. The charge continues to burn as it moves over additional burners. After the sintering operation, the resulting clinker is allowed to cool before being screened.

The properties of lightweight concretes show rather wide variations in respect to the relationship of cement content, strength and weight. For example various lightweight aggregates, even those produced by similar processes, require a considerable range in cement contents to produce concretes having equivalent strengths. Thus there is some logic in looking to the manufacturer of a particular material for recommendations concerning trial mix proportions. Properly designed mixes

using expanded clays, shales, slates and slags should produce concretes equal in strength to conventional concretes—but having, of course, greatly reduced weights. Structural lightweight concretes usually fall in the range of 90 to 120 pounds per cubic foot on a plastic or wet weight basis, or 80 to 110 pounds per cubic foot on an oven dry basis.

The modulus of elasticity of structural lightweight concretes ranges from ½ to ⅔ the values for concretes containing gravel, stone or air-cooled slag. Values recommended for use in design vary from 1.5 to 1.9 x 10^6 for expanded shale concretes having 2,000 to 4,000 psi compressive strengths, and from 1.9 to 2.5 x 10^6 for expanded slag concretes in the same strength range.

Lightweight concretes have excellent thermal insulating properties compared with normal concretes. Values for expanded slag concretes range from 1.5 to 3.0 BTU per hour per square foot per degree F. per inch; for expanded clay, shale and slate concretes the range is from 2.0 to 4.0.

The drying shrinkage of lightweight concrete tends to run somewhat higher than the drying shrinkage of normal concretes of comparable strengths. Some research findings show from 6 to 38 percent greater shrinkage for the lightweights.

A workable batch of lightweight concrete made with clay, shale, slate or slag aggregates has the same general appearance as a similar batch of conventional concrete. It should have enough mortar to coat and carry the coarse aggregates during troweling, without having an excess of fines. It should be sufficiently plastic for easy handling and sticky enough to hold together without cracking when vibrated or rodded.

Conventional procedures of proportioning concrete may be used with satisfactory results with coated lightweight aggregates characterized by sealed surfaces, rounded shapes, and low values of absorption. However, there are factors involved in the use of some lightweight aggregates that make the application of normal proportioning procedures difficult.

Since some lightweight aggregates are rounded with relatively smooth surfaces, while others are extremely angular with rough surfaces, there is a wide range in the amount of net water required to produce a concrete of a given consistency with different saturated aggregates. The net water needed to produce a 2-inch slump in non-air entrained concrete averages about 390 pounds per cubic yard of concrete. However, amounts varying from 300 to 450 pounds per cubic yard are used with different aggregates. This wide range in water requirement is reflected in a corresponding range of cement contents to produce a given strength. The structural strength of different aggregates also has an important effect on the cement requirement.

Some aggregates have absorption values of 12 percent or more, resulting in more than 200 pounds of absorbed water per cubic yard of concrete. Absorption may also continue for several days. Proportioning by absolute volume procedures, therefore, has its limitations, for it is difficult to determine correct values of absorption and the

One of the most important markets for lightweight structural concrete is for high-rise apartment buildings like this 30-story giant in Chicago. Lightweight structural concrete was used for the entire frame of this building.

specific gravity of the aggregate. Nor can the water/cement ratio of most lightweight aggregates be established as a basis of mix proportioning with sufficient accuracy.

The water absorbed by lightweight aggregates is evaporable, and apparently has no effect on the workability of the batch. Whether the aggregates are dry or have free surface moisture makes little difference as long as the moisture content is known and accounted for at the time of batching. Dry aggregate will produce concrete of lower unit weight than wet aggregate. Concrete made of saturated aggregates will be more vulnerable to damage by freezing and thawing than that made with dry aggregates. It is desirable, however, to have the aggregates damp at the time of mixing, to reduce the water absorbed by the mix and thus reduce the ratio of loss of slump. When the aggregate is in a less than saturated condition, it is recommended that the aggregate be mixed with about two-thirds of the required mixing water for a short time prior to the introduction of cement and air entraining admixtures. This procedure reduces the effective loss of cement into the vesicles in the surface of porous aggregates.

Most lightweight concrete will have from 2 to 4 percent entrapped air, but additional entrained air is usually desirable for both workability and durability. Where freezing and thawing are likely to be encountered, all lightweight concretes should contain at least 6 percent total air.

The grading of fine and coarse aggregate is important. Well graded aggregate will have a minimum void content and will require a minimum amount of paste to fill the voids. The result will be the most economical use of cement and maximum strength with minimum volume change due to drying, shrinkage and temperature changes.

Lightweight aggregates require a larger percentage of material retained on the finer sieve sizes, on a weight basis, than do heavier aggregates to provide an equal void content. Generally, for ¾-inch maximum size aggregates, material passing the No. 4 sieve should be from 40 to 60 percent of the total aggregate, based on dry loose volume. As the maximum size of aggregate decreases, the proportion of fine aggregate increases. With air entrainment and richer mixes a lower percentage of fines is normally used. The amount of fine aggregate is generally kept as low as possible while still providing a margin of safety for good workability. However, the use of an excessive amount of coarse aggregate will reduce the strength of the concrete.

As the determination of a satisfactory value for specific gravity and absorption of the aggregate is difficult with expanded clay, slate, shale and slag, tests have indicated that the use of a specific gravity factor will enable calculation of batch quantities in the usual way. This factor represents the bulk specific gravity that one would need to use to determine the actual weight of dry aggregate, allowing for an actual loss of water due to absorption.

The specific gravity factor can be calculated from any batch of concrete where known weights of materials are used, and where tests are made for entrained air content and unit weight. As a method of proportioning lightweight concretes, this factor is computed from a trial mix, the proportions of which have been determined from experience. As a means of field control, after a satisfactory mix has been determined, the specific gravity factor provides a method of immediate adjustment to batch quantities made necessary by changes in specific gravity or absorption by the aggregates. For any given concrete mix, a chart may be prepared to show the change required in total batched quantities of dry aggregate as the specific gravity factor varies.

The calculation and use of the specific gravity factor from trial mixes is given in detail in ACI Standard 613-A59, *Recommended Practice for Selecting Proportions for Structural Lightweight Concrete.*

Satisfactory results with clay, shale, slate and slag lightweight aggregates require adequate mixing time, and a longer cycle than with conventional concrete. Mixer speeds should be increased slightly, due to the greater difference in weight between the cement paste and the aggregates. A recommended minimum cycle time is 3 minutes, although there will be variation with different types and sizes of mixers.

The complete recommended procedure is as follows:

1. Charge the mixer with 65 to 75 percent of the total water and all of the pre-wet aggregate.
2. Mix for about 1 minute.
3. Add cement, any admixture, and the balance of the mixing water.
4. Mix the whole batch.
   a. 60 seconds for 1-cubic yard mixers or less;
   b. plus 15 seconds for each cubic yard or fraction thereof of additional capacity.

With transit mixers, the same procedure should be followed, but the total time before discharge should be a minimum of 15 minutes. The mixer should be rotated at high speed for not less than 15 revolutions just prior to discharge.

It is recommended that lightweight concrete be handled into place as rapidly as possible, and with a minimum of manipulation. The ideal method of transportation is in bottom-discharge buckets. Close supervision is needed to prevent malpractices that may lead to segregation. Since it has lower density, lightweight concrete can be adequately handled at lower than customary slumps, but it

Expanded slag lightweight structural concrete was an important feature in the design of this bus terminal in Pittsburgh.

must be watched for excessive bleeding. Should bleeding become unmanageable, owing to excessive rehandling of the concrete between mixing and final placement, it may be necessary to use an admixture of up to 2 percent calcium chloride.

Should the mix tend to stiffen unduly during transportation and placing, the cause is often water absorption by the aggregate. Either more mixing water or pre-wetting to a higher moisture content will generally correct this condition.

Lightweight concrete has a tendency to entrap air pockets and to form honeycomb because of its lighter weight. This situation can be overcome with a properly designed mix and by proper vibration, but over-vibration must be avoided.

Excessive floating and troweling of horizontal surfaces will bring the coarse aggregate to the surface in the same way as over-vibration. It is best to use a high frequency vibrating screed to strike the surface to level; conventional screeding may be adopted with caution. Screeding should be followed by jitter-bugging to force the coarse material down below the surface, leaving only the mortar on top.

Conventional floating and straightedge methods are then used, but the number of passes should be kept at a minimum. After floating, work should be suspended until water appears on the surface of the concrete and then begins to disappear. Depending on weather conditions, this usually takes from 40 to 60 minutes, and sometimes longer. Some contractors, instead of waiting, prefer to dust the surface with cement and sand driers at the time of maximum water gain. There is some controversy regarding the better method, but the former practice yields uniformly satisfactory results.

The slab is then ready for the final finish. This may be carried out in any of the customary ways with equipment and techniques similar to those used with conventional concretes. That is, with steel trowels, finishing machines, textured surfaces, or special finishes.

Lightweight concrete must have adequate curing. In this respect, however, it is no different from other structural concrete. There is even some evidence that the moisture absorbed by lightweight aggregates furnishes concrete with a reservoir of water for internal curing.

Field control of structural lightweight concrete is relatively easy. If aggregate moisture varies, the slump test can be employed to control mixing water content. The cement content will vary with changes in specific gravity and in the grading of the aggregates. Frequent tests of the unit weight of the fresh mix should be made. It is also wise to check the amount of entrained air periodically. A change in the unit weight of the fresh mix will indicate a change in air content or in the weight of the aggregates. A test of the air content by the Roll-ometer Method (ASTM C-173) will determine which it is. Should the weight of the aggregate have changed, this will be due to a change of moisture, a change in grading, or a change in density. Standard tests can be used to check each of these items.

The techniques of proportioning, handling, placing, and finishing lightweight structural concrete are somewhat different from those employed with conventional concrete. Suggestions and recommendations discussed here have been general; information supplied by manufacturers relative to specific materials should be consulted. END

Electrician wraps scotch tape around overlap of lengths of reinforcing fabric, the strip of asbestos cement lumber separating the lengths and affording electrical insulation. Copper bar at left (arrow), through which potential is applied to the wire fabric, will also serve as heating element in the completed floor slab.

Reinforcing Doubles as Slab Heating Element

AN UNUSUAL HEATING SYSTEM, in which the reinforcing wire fabric in a building's concrete floor slab serves also as an electric heating element, has been installed as a test in a building subject to normal use and under everyday conditions, including North Dakota winters which sometimes produce minus 40 degree temperatures. The double use of welded wire fabric in the floor slab (as reinforcement, and as heating element) is expected to represent a saving over the cost of the more conventional systems of radiant heating, such as copper tubing for circulating hot water, or especially manufactured electric resistance cables. The elimination of furnace equipment likewise cuts costs. Balanced against this, however, is the cost of the necessary transformers ($675 each, in this case).

Another economy incorporated in this design is that the floor grid will be energized primarily at night to store heat in the floor and underlying area, thereby eliminating an increase in the daytime demand factor. Baseboard type resistance heating is provided to supplement the stored heat during late afternoon hours. However, if required, a thermostat will override the preset schedule to energize the floor grid during daytime hours.

The test installation is a 6,500-square foot warehouse for Northern States Power Company on the outskirts of Minot, North Dakota.

In effecting dual use of the wire fabric as both reinforcement and electrical conductor, the major problem was how to accomplish both these functions without impairing one or the other. To be effective as reinforcement in a concrete slab, welded wire fabric must be overlapped to assure continuity of its crack-controlling ability. In order to maintain a proper flow of current, it was essential to electrically separate the overlapping lengths of fabric. This was effected by placing between the lengths of fabric a 2-inch wide, ½-inch thick strip of asbestos cement lumber tied securely in place every 12 inches by electrical scotch tape, wrapped about the sandwich formed by the insulation and the overlapping wires.

In order to apply the electric potential to the lengths of wire fabric, and establish a path for the flow of the current, ¼- by 3-inch wide copper bars were welded across the full width of each length. At the ends nearest the transformers, which hugged the central partition wall (between the warehouse area and the offices and shops), these bars were five feet long; but at the far side, the copper buss bars were almost ten feet long. They bridged two strips of fabric and served to conduct the current from one length to its immediate neighbor. Thus the current, led by cable from the transformers to the end of one length of fabric, followed a U-shaped path, down one length, back the other, and back to the transformer.

In order to facilitate the placement of the wire fabric, the welding of the copper buss bars, and the insulating and tying of the overlapping lengths, the designer specified that the floor slab be constructed in two stages. The first stage was a 2-inch thickness of unreinforced concrete placed over a polyethylene vapor barrier on well-compacted fill consisting of 6 inches of selected gravel. The surface of this first course of concrete was purposely left rough for bonding with the next course. Using this surface, the electrical con-

Welder tacks longitudinal wires of length of welded wire fabric to 3- by ¼-inch copper bar. Clamps keep wires and bar in close contact. Acetylene torch flame temperature is in 2200- to 2400-degree range—hot enough to weld, but not hot enough to burn wire.

Electrician tightens cable-connecting lug to copper bar at end of length of wire fabric. Fabric is laid out on previously placed 2-inch course of unreinforced concrete over polyethylene vapor barrier, will be embedded in top 4-inch thick course.

tractor was able to place the fabric, attach the buss bars, and tie the insulation without danger of breaking or damaging the fragile strips of asbestos cement.

With the fabric in place, cables bolted to the buss bars and led to the transformer locations, and electric tests made to be sure of proper current flow through the grid, the remaining four inches of concrete slab was placed. Conventional concrete was used, and concreting was done in the normal manner.

The only departure from usual wire reinforced concrete construction procedure was dictated by the extreme care taken to prevent displacement of the fabric lengths or damage to the insulation. Usually, wire fabric is supported or hooked up into the concrete as it is placed. In this case, however, it was decided to leave it in position on the previously placed 2-inch course of concrete, with the expectation that some slight displacement upward would occur (without damage to the insulation) and thus it would approach the ideal position.

The 3,000 psi 28-day ready mixed concrete was allowed to moist cure 7 days under Sisalkraft. The floor area of each half of the building was divided into five slabs, each measuring approximately 17 by 40 feet. The odd numbered slabs were placed first, and after initial set the forms were pulled and the even numbered slabs butted up against them. Later, 1½-inch deep contraction joints were sawed between the slabs.

Six dry-type transformers will be used to power the radiant networks of welded wire fabric in the concrete slab. Two hundred and eight volts will be applied to the transformers, but the potential applied to the wire will be only 20 volts. The current flow in the fabric is calculated to be in the 500-600 ampere range, with 45 to 55 amperes in each of the 11 longitudinal wires in each strip of fabric.

The calculated currents in the welded wire fabric are designed to emit 20 watts per square foot in the warehouse area, or a resultant floor surface temperature of 80 degrees, and 15 watts per square foot in the office-shop area, with a slightly lower floor temperature, because of the auxiliary baseboard heating.

Temperatures in the Minot building will be controlled by a system of thermostats, four embedded in the floor slab itself, and others measuring the air temperature, both inside and outside. These stats will control the heating system, predict coming temperature changes and demands, and actually switch the transformers on and off. Because of the tremendous currents involved on the output, or fabric side of the transformers, the switching will be done on the 208-volt, or input side. Time clocks will be used in conjunction with the thermostats so that present schedules can be arranged in such a way as to take advantage of off-peak heat storage.

Engineers of the Northern States Power Company estimate that heating the new service facility in the Minot area will require about 300,000 kilowatt hours annually, or, at an estimated demand and energy rate of 1.5 cents per kwh, represent an annual heating bill of about $4,500. For over 105,000 cubic feet of space, the monthly heating average will probably be about $375. END

The ball of prepared grout, kneaded to the desired consistency, is passed down to the diver. Since the patch being made is just below the water surface, no protection is provided for the grout. Aluminum foil or wax paper would be used in deeper water.

GROUTING UNDER WATER

A FLORIDA CONTRACTOR has developed a successful technique for underwater cement grouting for the purpose of stopping leaks in the countless miles of seawall which must be maintained for waterfront properties. His method is to use a proprietary accelerating admixture in combination with portland cement and sand to produce an extremely fast setting, dense grout which will not shrink away from the sides of the crack being prepared, or experience the leaching away of cement paste due to the action of the water.

The seawalls on which this work was done, and which are shown in the accompanying pictures, are actually precast tongue-and-groove concrete bulkheads which are jetted into place and tied together with a cast-in-place concrete cap.* In theory the tongue-and-groove construction is designed to prevent the loss of material from behind this type of bulkhead, but severe leakage has been found to occur during heavy or prolonged rainfall. Although ordinary sand-cement grout can be used for stopping this type of leakage above the high-water line, it provides only the briefest relief when used below the water line.

The most successful mix has been found to consist of two parts of cement and one part masonry sand, with the accelerating admixture added to the dry ingredients to obtain the desired workability. It is, of course, essential to work with very small quantities. The materials are worked by hand, using rubber gloves for protection, to form a ball about 3½ or 4 inches in diameter. This ball of material is thoroughly kneaded until the heat of hydration indicates that the material is ready to be used. The best results are obtained when the ball of grout has the consistency of a soft putty. When the ball of material is ready for use, it is passed to a man in the water who works it into the cracks being repaired.

Setting time can be controlled by using a small amount of water to replace a portion of the accelerating admixture. The trick is to have just enough time to work the grout into the crack and strike off the joint, but also to have as little time as possible for the sea water to affect the material before it sets. Optimum setting time appears to be between 3 and 4 minutes. In shallow water the grout can be passed down to the diver without protection, but in water of any depth it is desirable to protect the grout with aluminum foil or wax paper.

Test cylinders of the grout mixture cured under salt water show an average compressive strength of 3,200 psi at 28 days, compared with 4,600 psi for the same mixture cured in air. This strength is actually a good deal more than is required.

Repairs of this type have been studied in service for about a year. No visible changes are apparent after this period of exposure to salt water and wave action, and the repaired joints appear to be dense and tight and to provide a good seal against leakage of backfill. Although equally good results have been obtained with expanding grouts used similarly, the corrosion of the iron in materials of this type results in unsightly patches.

The work described and pictured here was supervised by Misener & McEvoy, Inc., of St. Petesburg, Florida. END

Readers who would like more information concerning the accelerating admixture used for the work described in this article may obtain it by writing on their business letterheads to Concrete Construction Publications, Inc., P. O. Box 444, Elmhurst, Illinois.

*See "On-Site Precasting," Concrete Construction, July 1959, page 6.

FILE: Underwater Concreting

Top hats are fine for topping off ceremonies. But for all the work that precedes the ceremony, safe well designed uniforms will help prevent many of the accidents which tend to keep the construction industry near the top of the list of hazardous occupations. Here are some tips about uniforms and how to choose them.

BY JOSEPH KIRSHBAUM*

Proper Work Clothing Can Prevent Construction Injuries

WORK CLOTHING plays a more prominent role in on-the-job safety than is usually appreciated. The Institute of Industrial Launderers has long been active and interested in this field, since member companies of the Institute supply, on a rental basis, more than 90 percent of the work uniforms used in industry. The Institute has worked with the National Safety Council and the American Standards Association to help draw up standards of safety in work clothing.

This is a field of special interest in the concrete construction industry because much of the work is relatively hazardous. Compensation claims and insurance premiums are often so high that preventing even one major accident may well pay for a uniform program for many years.

Where employees furnish their own work clothing, they may well be reporting on the job "dressed to kill." Experience has shown that when the choice is left to employees, their tendency is to wear work clothing which is not good enough for any other purpose.

Unfortunately, such clothing has many "built-in" accident hazards. Consider, as an example, a situation that is relatively commonplace: the missing button on the shirt sleeve cuff. It doesn't seem important and the worker ignores it—until the dangling cuff gets caught in moving machinery and an injury is incurred.

Or consider another typical accident: a worker reports on a contracting job wearing a pair of old trousers that he has furnished himself. Purchased originally for street wear, the trousers have cuffs on the pant legs. The man climbs up to inspect some equipment. The cuffs catch on a projection and he falls. At the compensation hearing, his doctor testifies that he is disabled for life. There are countless projections around construction sites that trousers with cuffs can catch on, resulting in crippling—and expensive—falls.

Burns are also a major hazard when work clothing becomes soaked with oil or grease. Under these conditions serious injury may result from merely lighting a cigarette. Obviously flammable clothing (or clothing which has been impregnated with cement dust or foreign materials which can cause skin irritation) should be changed frequently. But greasy clothing creates a mess in the family washer, which wasn't designed to remove stubborn industrial stains, and so the hazard is tolerated.

Member companies of the Institute of Industrial Launderers insist upon one iron-clad rule—that any rips, missing buttons and other defects in the uniforms they supply be taken care of immediately after laundering. If your company does not use the services of an industrial laundry, it is advisable to insist that employees take the same precautions.

Uniforms should be practical and selected carefully with due consideration of on-the-job conditions. In choosing a uniform, the Institute sug-

*The author is president of the Institute of Industrial Launderers, Inc.

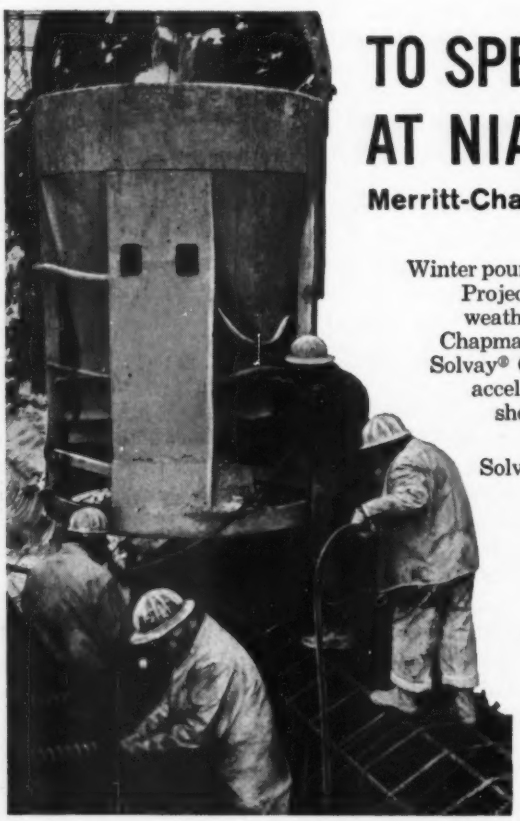
Employees look much better—and are far safer—in a uniform designed with safety under on-the-job conditions in mind. Nondescript work clothing of the hand-me-down street garment variety, often has serious, "built-in" accident hazards.

gests that the following points be kept in mind: (1) Cotton uniforms are best for most purposes. (2) Standard colors are preferable. (3) Unnecessary decoration should be avoided. (4) Company identification can be obtained by the use of well-designed company emblems. (5) Since drivers are more often seen by the public than other employees, their uniforms should always be clean and attractive, and should bear the company identification to assure their acceptance as its representative.

Finally, it is wise to have the uniform laundered several times by an industrial laundry in order to test such factors as shrinkage, color fastness and tensile strength loss.

The Institute of Industrial Launderers maintains a free consulting service for firms interested in adopting uniforms or changing their present uniforms. The sole objective of this service is to recommend general specifications which will assure that the new uniform will meet on-the-job conditions of the company concerned. END

Readers who would like to receive additional information on work clothes and the services of your local industrial laundry may request it by writing on their business letterheads to Concrete Construction Publications, Inc., P. O. Box 444, Elmhurst, Illinois.



TO SPEED WINTER CONCRETING AT NIAGARA POWER PROJECT

Merritt-Chapman & Scott uses Solvay Calcium Chloride

Winter pouring schedules at Niagara Power Project are maintained at near warm weather levels by contractor Merritt-Chapman & Scott. They do it by adding Solvay® Calcium Chloride to the mix to accelerate strength development and shorten the time concrete must be protected in freezing weather.

Solvay Calcium Chloride accelerates but does not change the basic action of portland cement. As an example, at 32°F a 2% addition accelerates set and development of early strength . . . 50% less protection time is needed. Ultimate strength is 2% to 12% higher, too.

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Here Solvay Calcium Chloride in the amount of 1% by weight of the cement is added to heated water used to mix winter concrete at Niagara Power Project. Total concrete used on this project to construct intake, power plants and conduits will be more than 3.5 million cubic yards . . . enough to build a 6-lane expressway from Chicago to Cleveland. When completed Niagara will be capable of generating more than 2,000,000 kilowatts of power, making it the largest hydro-electric development in the Western World. It is being built by the New York State Power Authority.

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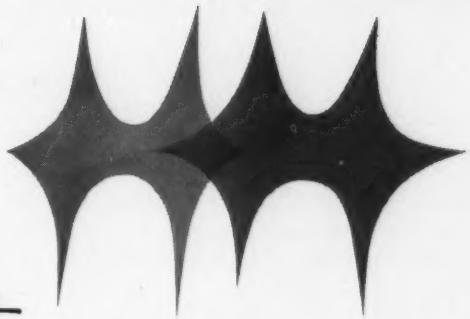

Concrete Industries

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Right now, the most progressive builders and architects in your area are getting set to tie in with the national Horizon Homes Program.

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Each home will be planned to demonstrate dramatically what imaginative uses of concrete can do for the modern home. The Program is sure to be of tremendous value to your business. It will make the public conscious of concrete home construction—as no other promotion has yet done!

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PORTLAND CEMENT ASSOCIATION *A national organization to improve and extend the uses of concrete*

Concrete Industries Announce Horizon Homes Program

The Concrete Industries' Horizon Homes program —a national effort involving all segments of the concrete industry for promoting the design, construction and ownership of new homes—has just been announced.

The first home merchandising program of its kind introduced by the industry, Horizon Homes is being jointly sponsored by the National Ready Mixed Concrete Association, the National Concrete Masonry Association, and the Portland Cement Association. Cooperating organizations include the National Association of Home Builders and the American Institute of Architects.

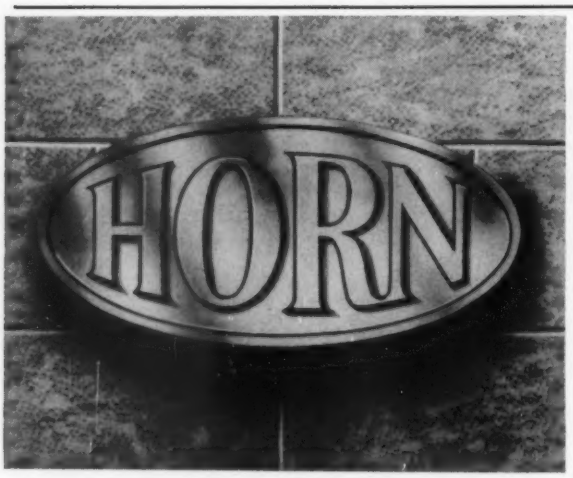
According to the participating groups, the Horizon Homes program has been developed as part of an industry-wide move to encourage design concepts and building techniques which will offer the home buying public more attractive, more livable and more comfortable homes.

At the same time, the program will dramatize to prospective owners the beauty, versatility and economy attached to the imaginative uses of concrete in new home design and site improvement.

Horizon Homes will make their debut in the fall of 1961 during the annual Parade of Homes observance of National Home Week—the country's biggest, single event furthering the cause of home building. The program will run continually thereafter.

Incentive awards have been established for architect participants making the greatest contribution in terms of creativity and the builders who have accomplished the most outstanding job of local merchandising. On a national level, the winning architect and builder, and their wives, will receive a trip to any place in the world. Seven regional runner-up prizes will also be awarded.

Public attention will be drawn to the Horizon Homes program through a variety of nationwide and local promotional activities.



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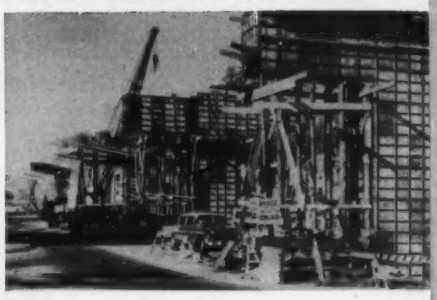

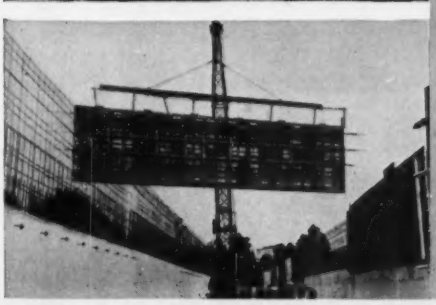

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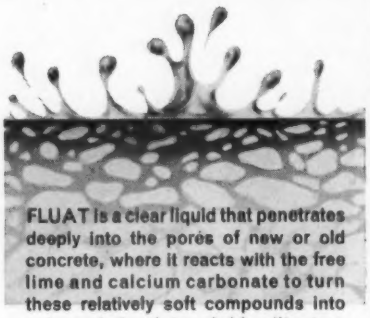

FLUAT is a clear liquid that penetrates deeply into the pores of new or old concrete, where it reacts with the free lime and calcium carbonate to turn these relatively soft compounds into extremely hard, insoluble silicates. These silicates completely fill and seal the concrete pores, creating a very dense and hard surface which actually increase the overall strength of a concrete floor!

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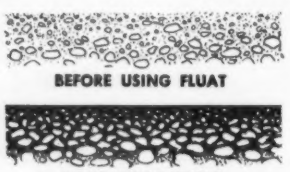

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bid depository

The Bid Depository of San Diego County, a cooperative, non-profit organization, has been formed to serve as a bid deposit and distribution center for the local construction industry. Offices of the new organization are at 3907 El Cajon Boulevard, San Diego, California, where the Allied Trust Fund Administration Service will act as bid custodian.

Function of the depository was outlined by E. H. Larson, president, who said, "This is a voluntary association of construction industry trade associations. Its purpose is to protect the great construction industry, in all its ramifications, from sharp practices which increase costs, weaken quality, and destroy public confidence."

Any awarding authority, whether architect, owner, governmental organization, or general contractor, may certify the San Diego Bid Depository as the official trustee through which subcontractors, suppliers, or others shall submit bids on a specific project. Use of the bid depository is provided awarding authorities without charge, but once the depository has been appointed for a specific job, the awarding authority must award the contract to the low acceptable bidder in each category on which competitive bids have been requested. Categories of work covered include electrical, plastering, plumbing, painting, roofing, and the work of other subcontractors and suppliers.

Bonded employees of the bid custodian receive sealed envelopes containing subcontractor bids, time-stamp the envelopes, and place them in locked boxes until the scheduled bid opening. Awarding authorities may reject bids from any bidder with whom he does not wish to work. This is done by marking the unopened bid envelope "rejected," signing it, and returning it to the bid custodian.

The Bid Depository of San Diego is intended to benefit all parties to a construction project by promoting ethical business practices and stimulating true competitive pricing. The bid depository system assures owners and awarding authorities the lowest practicable cost for each segment of a construction project.

The Bid Depository of San Diego was organized by the Construction Subcontractors Association of San Diego, a non-profit trade association. Functions of the depository and of the bid custodian are under supervision of the Board of Governors, composed of representatives from each subcontracting trade association, general contractors, architects, and engineers.

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Hugh Kirkland (Right), President, Kirkland Masonry, Inc., Miami, Fla., talking to Dick Rogers, his Dodge Representative.

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Daily Dodge Reports tell Mr. Kirkland all he needs to know: type of project and cost, names of owners, architects and engineers, names of general contractors bidding, results of the bidding, and award of the general contract. "We have to be there with a bid *before* the general contract is awarded because the GC has to incorporate our bid in his," Mr. Kirkland says. "Dodge Reports give us the facts we need *in time* to figure the job and get it!"

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☐ send full case history on Mr. Kirkland.
☐ have a Dodge Representative call.

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Company _____ Title _____

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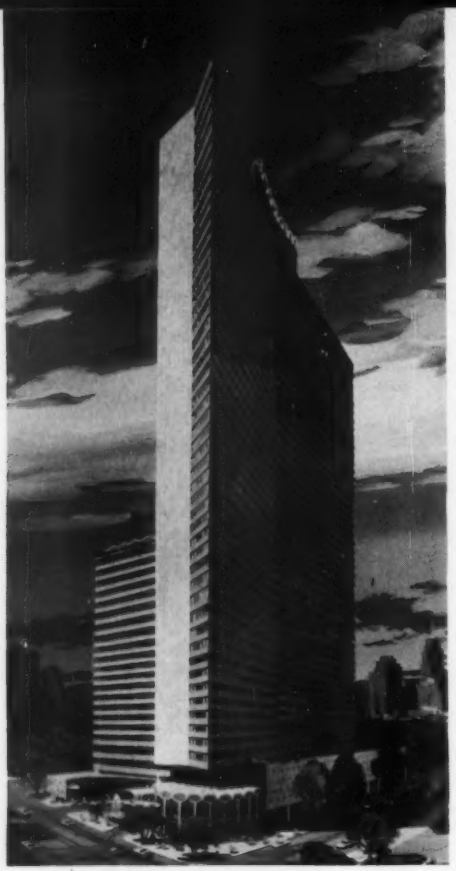
the Americana



for three major hotels concrete gets green light

REINFORCED CONCRETE has been selected for the construction of three major hotel projects now underway in Manhattan, according to Farkas & Barron, consulting engineers, who are doing structural design and engineering for all three properties. The three hotels are the 50-story, $50 million *Americana of New York,* Seventh Avenue and 52nd Street; *The Summit,* a 21-story, $25 million hotel at Lexington Avenue and 51st Street (both owned by Loew's Theaters, Inc.); and the 448-room, $9.5 million *River View Motor Hotel* being erected at 42nd Street and Twelfth Avenue by the Glickman Corporation of Nevada. Architect for all three hotels is the firm of Morris Lapidus, Kornblath, Harle & Liebman.

Most notable among the three projects is the Americana which will be the tallest reinforced concrete structure in North America, and the second tallest such building in the world, second only to the 507-foot high Sao Paulo Bank Building in Brazil. According to Nicholas Farkas, the Americana will be built of lightweight concrete with beamless construction.

The top 20 floors will be designed in flat plate and columns. Below that level a combination of tied columns and sheer walls will be utilized to provide a 24-foot, 4 inch module, with 7½ inch slabs in between. The width of the tower is planned at 56 feet 6 inches.

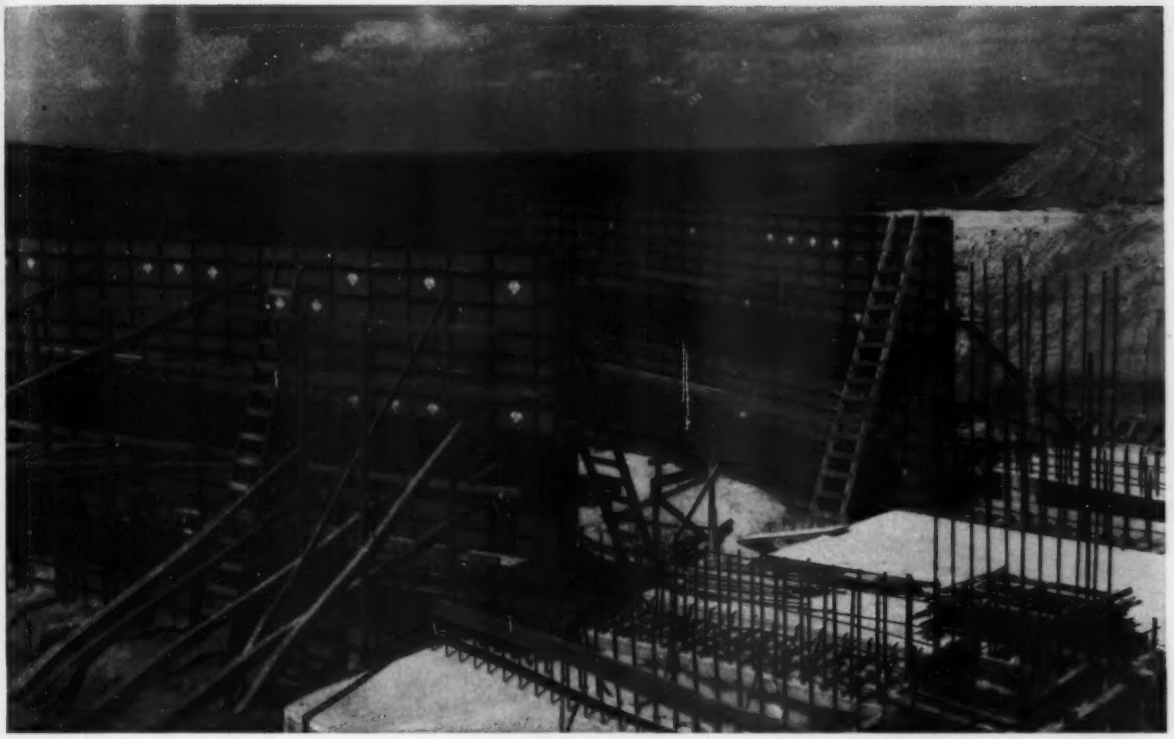
The combination of tied columns and sheer walls will provide a high rigidity to resist wind loads and the sheer walls as partitions will provide exceptionally high soundproofing. Below the tower level of the building, to provide for adequate circulation of large groups of people, the sheer wall design will be discontinued in favor of combination columns of concrete and structural steel.

The Summit will be 21 stories and have 800 guest rooms. The Summit is scheduled for completion in July, 1961. Engineering and design characteristics are similar to those being employed in the Americana. The Summit will be the first hotel constructed in New York City since 1931. Contractor for both The Summit and the Americana is Diesel Construction Company of New York.

The Glickman, River View Motor Hotel, overlooking the Hudson River, will have 16 stories of rooms including two penthouse suites. The first five levels will consist of parking garage and service station to accommodate 350 automobiles. According to Farkas & Barron, the structure is designed for flat plate beamless reinforced concrete construction, permitting all rooms and corridors to be constructed with flat ceilings. END

the Summit

the River View Motor Hotel



Operational Missile centers at Offutt Air Force Base.
J. Hilding Johnson, Inc., Gary, Indiana, contractor.

Symons Steel-Ply Forms Solve Missile Base Problems

Winter weather didn't stop J. Hilding Johnson, Inc., Gary, Indiana, contractor for the three operational Missile centers at Mead and Arlington, Nebraska, and at Missouri Valley, Iowa. Subbing 36,000 cubic yards of concrete work from prime contractor Malan-Groves, Johnson was prepared for winter, and shoved ahead its construction schedule to a 24-hour around-the-clock basis.

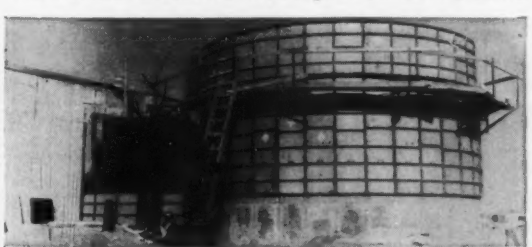
Symons Steel-Ply Forms were used to facilitate speedy construction and solve other contract problems.

Cut Over-All Costs

Direct number of carpenter hours in the field were reduced and administrative-wise, there were about 25 percent fewer men on which to issue checks, keep time records, and other necessary details.

Flexibility was Big Advantage

If weather interfered with a pour scheduled down in a hole, forming and concrete work still could proceed at some other location above ground.



Symons Steel-Ply Forms again prove their adaptability for circular forming.

Triple-Row Bracing or External Waling Eliminated

The corps of engineers required triple-row bracing or external waling on both sides. However, the corps gave permission to try one 25-foot-high wall, braced only on one side. Based on results, permission was given to use the system on the remaining work. Many man hours were saved. And the method cut weeks off the over-all construction schedule.

Eliminated Congestion At Job Site

Eliminating yard congestion at the job site was important, particularly during rainstorms and during the freeze-thaw cycles of early winter.

Complete Job Story on Request

There's much more to this job that was completed in 10 months rather than 2 years under normal conditions. Complete *Offutt Air Force Base Story* will be sent on request. Symons Steel-Ply Forms are rented with purchase option.

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SAVE MAN HOURS

SET, POUR, STRIP IN RECORD TIME

(16-22 MAN HOURS ON TYPICAL BASEMENT FOUNDATION)

CUTS ASSEMBLY TIME

Inner and outer forms are set at the same time. Forms go up "a foot a minute." Tie rods position easily. No other forms are assembled as fast as Simplex.

A COMPLETE UNIT

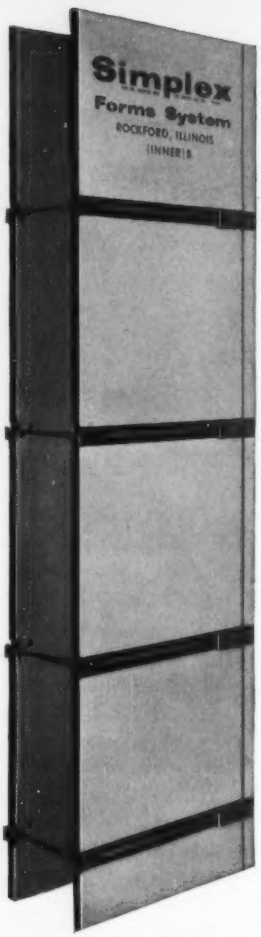
Each panel is a *complete form* with all hardware securely bolted in position. Fastening devices are not loose . . . can't be dropped or misplaced . . . thus saving man hours.

BEST FOR WINTER

Only rugged 9-ply plastic impregnated 1⅛" plywood is used. Plywood *insulates* . . . helps curing during winter work. Strips clean and leaves a smooth concrete surface.

PATENTED LOCKING LEVERS

A hammer is the *only tool* needed to set forms. A tap on the levers and their cam action draws forms together to make a rigid, accurate foundation unit.



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Available in graduated sizes from 2' 8" to 10'

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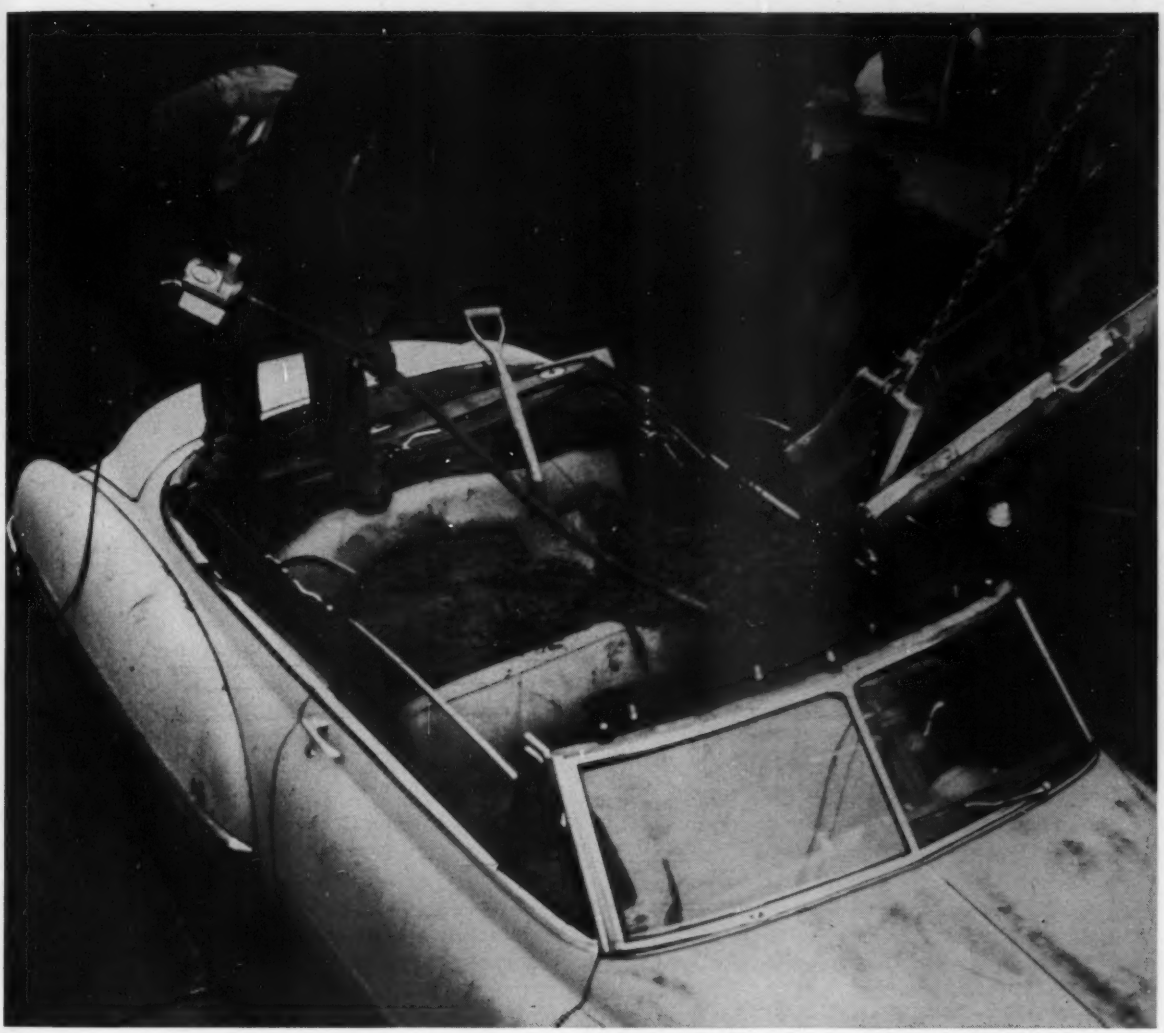
books

ACI 55-Year Index. *Published by American Concrete Institute, P.O. Box 4754, Redford Station, Detroit 19, Michigan. 400 pp. Members, $4.50. Non-Members, $9.00.*

No longer do you have to search three or four indexes to find the material that will help solve your concrete problems. This comprehensive listing and guide to all papers appearing in the ACI Proceedings and the ACI Journal from 1905 to 1959 opens the door to an accumulation of facts dealing with all phases of concrete — design, construction, research, manufacturing, maintenance and engineering. The papers listed in this Index comprise the chief product of the ACI. Approximately 18,000 entries are listed to aid your search into every significant development in the concrete field.

Manual on Good Concreting. *Published by Concrete Improvement Board of Metropolitan Detroit, P. O. Box 4663, Mt. Elliot Post Office, Detroit, Michigan. General Recommendation on Responsibility for Concrete Control, Sampling, and Testing Laboratories—3 pp., $0.50; Recommendations for Exposed Portland Cement Concrete Residential Paving—3 pp., $0.50; Recommendations for House Basements—7 pp., $0.50; Recommendations for Winter Concreting—2 pp., $0.50; Recommendations for Hot Weather Concreting—3 pp., $0.50; Ready Mixed Concrete Purchase Recommendation—2 pp., $0.50. Hard cover 3-ring binder for the recommendations $1.75.*

The Concrete Improvement Board of Metropolitan Detroit has published this manual which comprises the various recommendations listed above, and is planning future publication of other recommendations on such subjects as finishing of concrete



..."Well, the boss said never pour concrete without vibrating it."

"Now take this STOW EU Vibrator. The boss put these on the job because they're one of the best all round vibrators you can get. Plenty of wallop in that 1 HP motor. It delivers 10,000 VPM. And that head is just the thing for narrow forms, prestressed work, or just vibrating concrete into tight corners. That's why we always have these STOW EU's* around on the job. You can use 'em for just about any kind of vibrating. And look how easy they are for one man to handle!"

The man is right! Next time you pour concrete, put a STOW EU Vibrator to work!

Unusual application? You bet! And we'll bet you'll do better with a STOW vibrator next time you pour concrete on *any* job. Call your nearest STOW distributor for a try out . . . or contact us directly!

Complete line of Gasoline operated and motor-in-head vibrators, portable concrete grinders, ceiling grinders, rotary trowels, vibrating screeds, and tampers. Request Catalog 610 from your distributor, or write STOW.

**Available with shafts from 2' to 21' long and with 4 different vibrator head sizes.*

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MONEY, TROUBLE
with BURKE'S
• FORM SEALER
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BURKE FORM SEALER has proved its effectiveness on literally thousands of concrete construction jobs. This chemically processed solution of co-polymers and water-repellent resins—an exclusive Burke formula—seals and water-proofs the plywood form panels by controlled penetration. Dries overnight to a tough, alkali-resistant film that permits up to 10 or 12 pours with no retreatment. You get no retardation, no staining, no dusting problems, no transference or migration—just clean, smooth architectural concrete, pour after pour. Apply with *Burke Promel Roller*, power spray, brush (using regular formula) or by dipping (special dipping formula).

BURKE FORM COATING is a two-coat system of catalyzed polyurethane resin which, when applied properly, deposits a hard film on plywood forms, presenting a glass-like surface to the poured concrete. Unlike glass and most plastics, this film does not shatter when abraded, nor become brittle when aging. Do you want to make 40, 50 or more pours? Panels treated with this remarkable Burke formula, even after 60 pours, have continued to produce clean marble-like concrete surfaces. On account of its rugged resistance to abrasion, it is excellent, too, for slip form construction. Simply apply two coats using the *Burke Mohair Roller*. *Burke Form Coating* is intended only for raw wood. The performance of the *Burke Form Coating* system can be surpassed by no other form treatment.

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books

slabs, a buyer's guide for concrete, and others.

The compilation represents the cooperative effort of the various segments of the concrete industry in the Detroit area. It is intended as a practical guide to good practices, through which the level of excellence in concrete construction may be voluntarily elevated by its practitioners.

Concrete Engineering Handbook. *Edited by William S. La Londe, Jr., and Milo F. Janes. Published by McGraw-Hill, 327 West 41st Street, New York, New York. 1216 pp. Illus. $25.00.*

The concrete engineering and construction field is provided with a comprehensive and up-to-date reference on design methods and data for all types of concrete structures in this new handbook by 20 specialists. The book presents a wide range of material, including not only design methods for various types of structures, but also special resumes on structural theory, torsion, materials, and construction methods, many diagrams and tables, and other design aids.

A large section is given to the design of buildings and their elements. Also covered are concrete chimney design, bin design for bulk storage of materials, pavement design, bridge design, and design of skin structures. Special topics include the handling of deflections in building frames due to earthquake force, and applications of prestressed concrete.

In the section on building design, many tabular data have been conveniently brought together, including some especially prepared for this book. Tables are given to permit the rapid choice of concrete slabs, beams, and footings, once loads or moments, shears, and choice of fiber stresses are known.

Owner: City of Beverly Hills, Cal.; **Architect:** Welton Becket & Associates, Los Angeles, Cal.; **Consulting Engineers:** T. Y. Lin & Associates, Van Nuys, Cal.; **General Contractors:** C. L. Peck, Los Angeles, Cal.; Ellis E. White Co., Los Angeles, Cal.; **Precast Columns & T's:** Wailes Precast Concrete Corp., Sun Valley, Cal.

The five-story Beverly Hills Garage illustrated above, providing parking space for 400 cars, is a unique precast, prestressed structure. Long spans of 75 feet eliminated columns in parking areas and use of lightweight aggregate minimized both horizontal and vertical loading.

PLASTIMENT
Increases workability of lightweight concrete

Use of Plastiment Retarding Densifier increased the workability of the Ridgelite lightweight concrete thereby assuring a smooth, clean appearance to the exposed concrete members. Using high early cement, strengths averaged over 3,500 psi in 16 hours in the precast elements. Slab concrete placed at the site reached 3,500 psi in 2 days. 28-day strengths averaged 6,500 psi.

Mix contained 7-1/2 bags of cement per cubic yard and 2 fluid ounces of Plastiment per sack of cement.

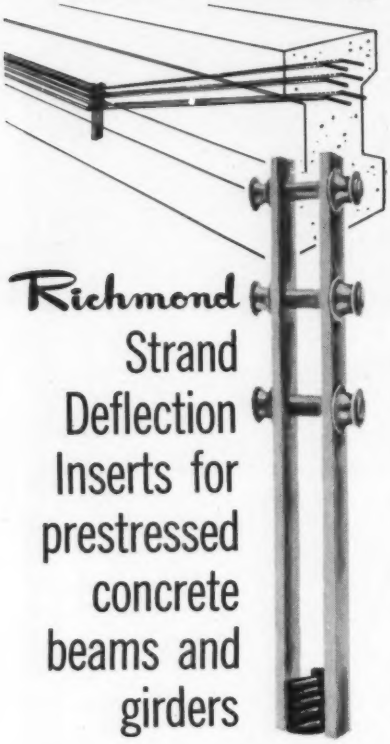
Plastiment features are detailed in Bulletin PCD-59. Ask for your copy. District offices and dealers in principal cities; affiliate manufacturing companies around the world. In Canada, Sika Chemical of Canada, Ltd.; in Latin America, Sika Panama, S. A.

Sika

SIKA CHEMICAL CORPORATION

Passaic, N. J.

Pretensioning



Richmond Strand Deflection Inserts for prestressed concrete beams and girders

Included in Richmond's complete line of inserts and accessories for prestressed concrete are a variety of strand deflecting devices, designed to accommodate ¾", 1" and 1¼" bolts or eye bolts to suit your project and match your pretensioning bench.

Richmond Strand Deflectors are manufactured for single, double and triple lines of strands and are available with or without keepers or rollers.

There is a standard line of Richmond Strand Deflection Inserts but, since requirements for deflecting devices vary widely, special units can be manufactured on request to suit individual needs.

For information about Richmond-engineered Strand Deflection Inserts for prestressed beams and girders contact us or our distributors: Intercontinental Equipment Co., Inc., 120 Broadway, New York 5, N. Y....and if you have a specific concreting problem, ask our Technical Department about it—they can help you. Write to:—

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products

calcium chloride

A folder, "Calcium Chloride for Concrete Construction," is designed for ready mixed concrete operators, contractors, and engineers who wish to accelerate the set of concrete, especially when outside temperatures fall below 70 degrees F. The folder lists major beneficial effects of using calcium chloride for this purpose, contains charts on early compressive strength, calcium chloride with air entrained concrete, and tells how to prepare and use calcium chloride in standard solution. Available from Calcium Chloride Institute, 909 Ring Bldg., Washington, D. C.

truck and trailer size

A 66-page booklet describes truck and trailer size and weight restrictions for 1961 in the United States and Canada. The booklet can be obtained by writing FWD Corp., Clintonville, Wisc.

shell roof techniques

A new 19-minute motion picture, "How To Build New Shapes in Concrete," describes many of the popular shell forming developments, including movable forms, lightweight scaffolding, precast and earth forms. It also treats the use of prestressing in shell design, as well as the use of shells in lift-slab buildings. Concreting techniques include pneumatically sprayed shells. This film serves as a companion film to the recently released motion picture, "New Shapes in Concrete," which deals with the architectural versatility of shell roofs. Intended for showing to contractors, engineers and architects, the film is available on loan from the Portland Cement Association, 33 W. Grand Ave., Chicago, Ill.

tool pouch

A leather tool pouch designed to fit over a regular belt holds both nails and tools in one lightweight unit. In addition to the nail pocket, the tool pouch has specially designed pockets to hold a steel rule, an all-purpose cutting knife, a hole saw and a drywall hammer or carpenter's hammer. Goldblatt Tool Co., 1910 Walnut St., Kansas City, Mo.

power trowels

A power trowel for any job may be chosen from this manufacturer's line of 6 different units. These trowels have low centers of gravity for easy, stable operation with no pulling or tugging on the operator. One-point lubrication and simple design make maintenance easy. Gear cases are equipped with lifetime bronze gears running on a steel worm and 4 Timken bearings. Stationary guard rings permit working right next to walls or columns and provide a strong and convenient carrying method. For details write Kelley Machine Division, 285 Chicago St., Buffalo, N. Y.

scaffolding

A new bulletin, "Scaffolds for Aerospace and Electronics Programs," describes with illustrations how steel and aluminum scaffolding, shoring, ladders and related equipment can be used for off-the-ground working platforms. Some of this equipment is standard scaffolding used in construction. Other scaffolds involve special designs. Write for bulletin G212. The Patent Scaffolding Co., 38-21—12th St., Long Island City, N. Y.

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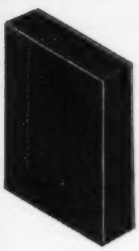
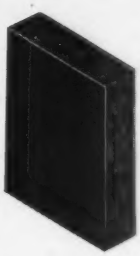
FOR CONCRETE CONSTRUCTION

A TYPE TO MEET YOUR EXACT REQUIREMENTS



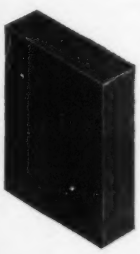
ASPHALT EXPANSION JOINTS

Suggested for almost every type of joint installation. Offer low initial cost, great durability, and are completely waterproof. They are rigid and easy to install in perfect alignment . . . will not deform in hot weather or become hard or brittle in cold weather. Offer excellent compression qualities. Preformed of a bituminous material bound together in a tough, shock resistant mass with a fibrous binder and formed between two asphalt saturated felt liners which add strength and rigidity.



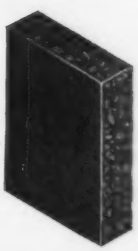
CORKFILL EXPANSION JOINTS

Ideal for installation in residential, commercial, institutional and industrial floor slabs where resiliency and non-extruding properties are important. They have a high tensile strength, may be compressed to 50% of original thickness and will recover to 70% of original thickness . . . assures a tightly sealed joint at all times. Made up of a shock-proof mass of clean, regranulated cork particles uniformly combined with pure blown petroleum asphalt. This asphalt-cork composition is produced under heat and pressure formed between two asphalt saturated felt liners.



FIBRE EXPANSION JOINTS

Suggested for use on highways and airport runways with a rubber asphalt joint seal applied over the joint. Fibre joints are easy to handle and install. When compressed to 50% of its thickness it will recover better than 70% of original thickness. Made of a preformed material composed of durable cane fibres of a cellular nature, uniformly impregnated with pure blown asphalt to a weight of 35% to 50% of the entire mass. This impregnation waterproofs the fibres, but does not affect the natural resiliency of the expansion joint.

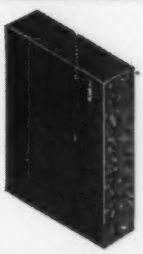


PLAIN CORK EXPANSION JOINTS

Sealtight Plain Cork Expansion Joints are composed of selected cork granules and molded with a resin binder. Suggested for use wherever it is essential that joints be kept filled at all times, such as in sewage plants, flood walls, water filtration plants, bridges, etc. They offer excellent resiliency . . . will compress without extrusion and recover to 95% of original thickness. Available in cut sizes or slabs.

GRAY SPONGE RUBBER EXPANSION JOINTS

Gray color provides a joint that blends with the adjoining concrete. Ideal for use in residential, commercial, institutional and industrial installations where the joint will be visually exposed. Fully compressible . . . has a recovery rate over 95% of its original thickness. Offers low moisture absorption . . . is easy to handle in all temperature conditions and is non-extruding. Composed of a high quality blown sponge rubber of uniform thickness and density.



SELF-EXPANDING CORK EXPANSION JOINTS

Sealtight Self-Expanding Cork Joints are made of selected cork granules molded with a resin binder and specially treated to permit an expansion of as much as 50% over original thickness. It is fully compressible, non-extruding and very resilient. When installed, a self-expanding cork joint will keep the joint area filled even when the joint opens wider than original size. Available in cut sizes or slabs.

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Illustrates and describes the complete line of Sealtight Products used in the construction of highways, airports, buildings and other concrete construction projects of all types. Comprehensively describes the products, their applications and corresponding specifications. Request your free copy of Catalog No. 1001 today.

*. . . a new terminology for Expansion Joints selected because it better describes the *need for* and *use of* joints in well-engineered concrete construction. Sealtight Control Joints are ideal for highways, pavements, runways, buildings of all types, ramps, bridges, etc. . . . especially desirable for use wherever good design requires a top-quality joint filler for the control of cracking, warping and to relieve stress in concrete construction. SEALTIGHT Control Joints are produced to strict quality standards . . . available for immediate delivery from your local SEALTIGHT Distributor.

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For lightweight concretes of PROVEN Performance in . . .
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Other applications include thermal and sound insulation, structural concretes.
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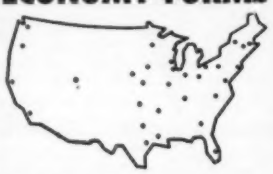
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products

roof deck concrete mixer

A machine for mixing lightweight concrete for roof decks is loaded with the ingredients at ground level and discharges the mixed concrete on the roof through a hose in heights up to 20 feet at 250 feet on the horizontal. The bucket lift, bucket door and discharge gate are all hydraulically controlled. Engine clutch levers and hydraulic valves are controlled from the operator's platform. Production in excess of 1100 square feet per hour with a 5-man crew has been reported. Write Concrete Transport Mixer Co., 4975 Fyler Ave., St. Louis, Mo.

lightweight concrete

The wide use of lightweight aggregate concrete in modern construction is featured in this 20-page publication. Photographs and job reports present a clear picture of the wide variety of uses for this relatively new and versatile building material and emphasize the importance of additives in providing adequate workability for proper placement while economically maintaining sufficient strength to meet structural requirements. Thirteen construction projects are featured with discussions covering the use of lightweight concrete as a strong, durable structural material for columns, beams and floor slabs, multi-story structures, thin shell concrete and bridge decks. Bulletin MBR-P-14 is available from The Master Builders Co., Cleveland, Ohio.

space heater

An 80,000 btu construction heater features a 2-pass stainless steel combustion chamber that burns objectionable odor and smoke. A 16-gauge steel fuel tank provides for 20 hours continuous operation and longer when thermostat-equipped. A 3-way shutoff valve in the fuel line eliminates smoke and odor on shut down and intermittent operation. Parts are easily accessible for maintenance and repair. Write White Mfg. Co., Elkhart, Ind.

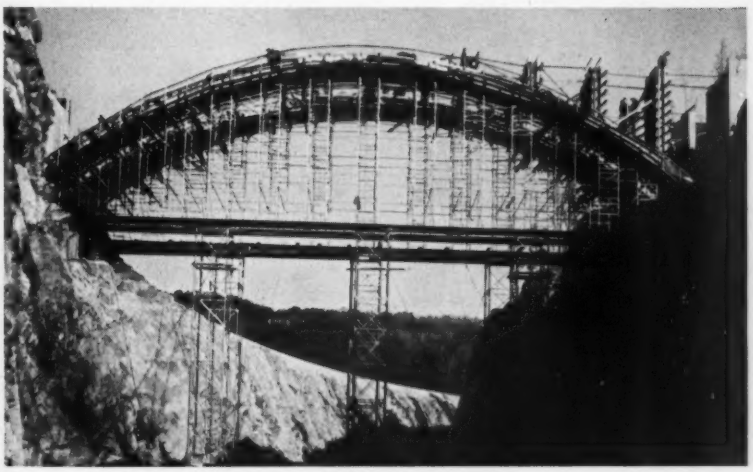
basement window

A sliding basement window of aluminum, designed to fit most frames and surrounds, eliminates any protrusion into the room, allows complete ventilation control, and is said to admit more light than do most basement windows. Conventional drapes and blinds may be used with this unit and panes lift out from the inside for easy cleaning. Aluminum frames, extruded plastic slides and fiberglass screens virtually eliminate maintenance and enhance any architectural style. Quick snap-in installation is another feature appreciated by both contractor and home owner. Write Gates and Sons, 80 S. Galapago, Denver, Colo.

fall-out shelter

Plans for a fall-out shelter which provides the home owner with a practical shelter at lowest possible cost and the builder with an added sales feature have been developed by Simplex Forms System. In addition, the shelter is ideal for protection in areas where tornadoes, cyclones, hurricanes or violent storms are likely to occur. The 11- by 11-foot shelter may be used as a recreational area or hobby room. Plans may be obtained from the Director of Sales, Simplex Forms System, 5605 Industrial Ave., Rockford, Ill.

New Heavy Duty 20K Frames Easily Shore . . .



. . . 8'-wide ribbon arches

For the 143'-long concrete bridge at Hogback Dam, Riverton, Conn., PS Co.'s new 4'-wide 20K heavy duty frames (designed to safely carry 10,000 lbs. on each leg) of "Trouble Saver"® Sectional Steel Shoring are quickly erected and spaced atop long I-beams to support 9,000 lbs. per leg imposed by columns and two ribbon arches 8'-wide by 1½' to 3'-thick, 34' center height. This shoring is supported by six 48'-high towers of PS Co.'s Extra Heavy Duty Shoring, which carries a total load of 32,000 lbs. per leg. White Oak Excavators, contractor.

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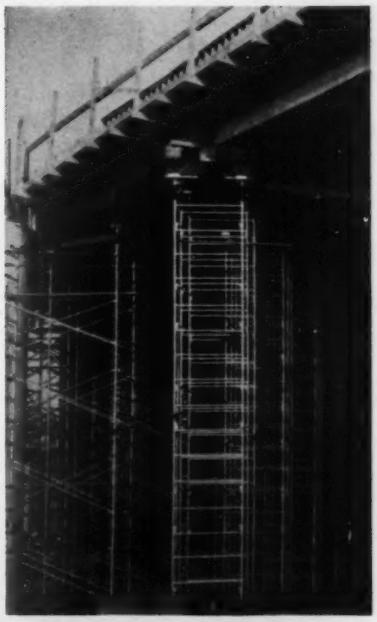
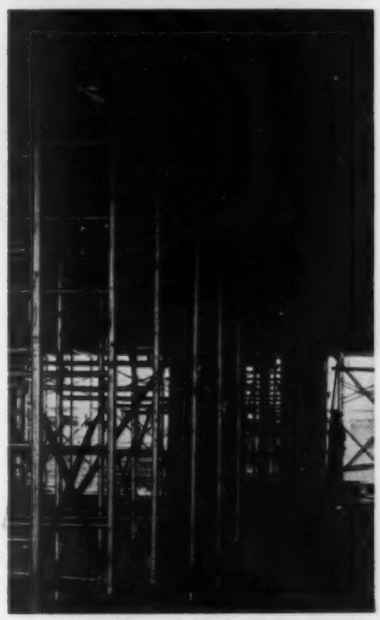
. . . 4'—5' Freeway girders

13,900 heavy duty 20K frames are now being used by Griffith Company, contractor, to support the heavy concrete box girder design of the six-mile Santa Monica viaduct connection, 15' to 33' high, to a Los Angeles Freeway. Bottom slab of box girders is 5½" x 6½" thick; top 5" to 5½" thick. Box depth is 4' to 5', made in three pours.





. . . 12¾" grid-type slabs

Here, 20K heavy duty frames are spaced 3'11" apart to support horizontal shoring for grid-type floor slabs. Floors in this 11-story Florida National Bank Building, Jacksonville, are 12¾"-thick. 20K frames are also used to shore heavy spandrel beams on the second floor only. George A. Fuller Co., contractor.

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